McGinley Dynamics ©1990

2

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Introduction

Moving averages (MA) have been used for years by technicians for data smoothing, and in various trading systems because of their calculation simplicity. Investors know prices vary greatly, and will easily embrace anything that seems to simplify the confusing patterns raw prices sometimes produce. Many use moving averages in place of, or together with, among other studies, trendlines. It is the contention of this paper that moving averages are often overused, can be inappropriately applied, and most importantly, have at least one overriding problem not hitherto effectively overcome, a problem this paper will address

Consider: in one market a 10-day average might be à propos, but in the next, a 21-day might be better, as one market might be faster or slower than another. Most moving averages are fixed in length and never change, a senseless restriction that hamstrings the user and that frequently leads to inaccurate smoothing and possibly erroneous conclusions. To adjust a moving average to its best length is a time-consuming exercise demanding extensive trial and error, not to mention the programming changes required. Better would be a type of moving average that adapts itself automatically to the situation, speeding up when the market accelerates and slowing down when the market decelerates.

This paper will profile the representative types of moving averages, detail their benefits and shortcomings, and finally provide an effective new solution to the problems raised: the **McGinley Dynamics**.

Moving Average Background, Calculation, and Benefits

There are numerous ways to calculate a moving average.[1] There are also very sophisticated replacements for it, such as various types of weighted, exponential, power fits, up to even the Savitsky-Golay calculation.[2] Each has its good and bad points. We will touch on several other techniques as we go along. A relatively simple calculation will be found to solve a number of the problems previously identified.

The basic moving average calculation simply totals the last x days' data and divides by x. There are many common lengths of moving average. One sees 10, 21, & 200-day averages, to mention only a few. In their periodic writings, for example, analysts such as Tillman, Crawford, and Prechter among others, have proposed well-considered arguments for utilizing the length of the lunar cycle, with quarter, half and doubled cycles thrown in. Many stick with standard 50, 100, 200 or other-day moving average lengths; others optimize to find the best-fitting moving average for the current data. None of these lengths are THE answer.[3] Logically, there is no one "right" window for a moving average in all markets, at all times; markets can and do vary between fast and slow, requiring moving averages of different lengths to track the data. Personal preferences also come into play: some want to track the data more closely than others.

Most importantly, and oft forgotten in people's use of a moving average, is just exactly what it was created to do. A moving average is not a trading system, a magic wand, or a signal giver. It is nothing more than a mathematical smoothing mechanism and a very simple one at that. When data are highly volatile, a moving average can often "tame" its gyrations and expose a trend that might otherwise not be evident. Attempts to make more of a moving average than this forget its basic raison d'être.

A feature of the moving average calculation is its ability to rise in the face of a falling datum; this occurs when the dropped datum x_{+1} days ago is much less than the new one, and the average surprisingly rises. This can be good or bad, for the moving average either whipsaws about the data badly, or on the other hand it smooths/filters outlying data that may appear ominous but that in reality are not. We will shortly see how the *McGinley Dynamics* makes use of this ability.

The moving average is used in other mathematical calculations. While the calculation details are not important, examples are the standard deviation of which it is a part, and John Bollinger's Bands[4], set two standard deviations above and below the moving average. Percent bands above and below the MA, as used by Gerald Appel, are along the same idea, they are although calculated differently. All of these calculations anchor themselves to the moving average running through the raw data.

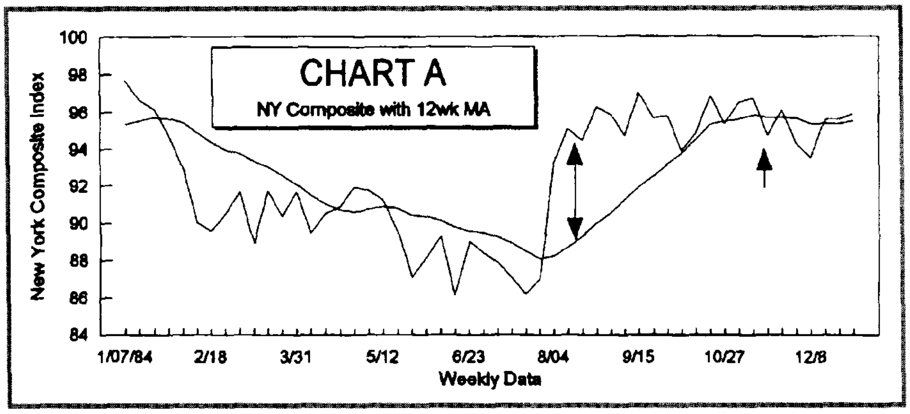
Moving Average Problems

The simple moving average has several well-known problems. First, it is always out of date by half its length; e.g. in a 10-day moving average, the average is that of 5 days ago and much of importance may have happened since. Practically, the moving average is usually placed/graphed – incorrectly – at the end of the period, i.e. in the example, on the 10th day. Technically, while rarely done, to describe the data properly, it should be plotted at the 5th day, i.e. five days ago.

A real problem is that of the large dropoff. The reverse of the above, a new data item at the same level as the current, say ten-day, moving average would be expected not to alter it. However, if the data item being dropped x_{+1} days ago is much larger than the present average reading, the moving average will "inexplicably" drop in the face of flat new data. This could cause the unwary to draw incorrect conclusions about what is happening.

Yet another problem is all the data one must remember/keep. In this day of computerization it is not as great a problem as in the day of pen and pencil; nevertheless, the computer code changes required, if one wishes to alter the length of the moving average frequently, are complicated and time intensive.

It is my feeling, however, that the moving average's major problem is its fixed length. In a market that suddenly becomes fast rising, the market frequently far outruns the moving average. Notice how in chart A (see over), circa September 1984, the length of the double-headed arrow indicates by how much the price has outrun the moving average. (Note as well how the average goes into the middle of the consolidation area, indicated by the arrow at the right, an additional problem we will deal with later.) If the market suddenly turns down, the market must fall a long way before it finally contacts the slow moving average. This does the technician no service, as it does not describe the fast-moving data.

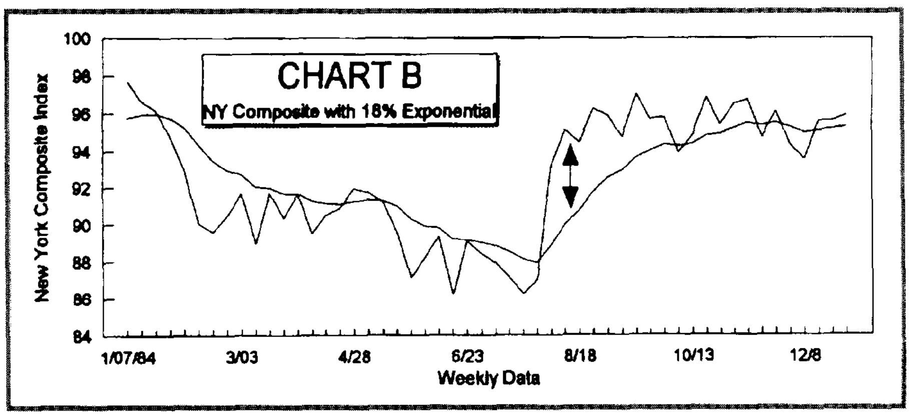


we need is for the calculation to adjust. And if it were possible for the calculation to do it automatically, so much the better.

Other, more complicated moving averages can be created by making B the square of something, or the log of the absolute value of something (absolute means dropping the minus sign if any, so you don't have to deal with negative numbers – which logs abhor!), or where B actually is the exponent of something (power fit)[5]. The details are not important for the purposes of this paper, but it is well to know more complicated variations exist.

The Exponential and Other Moving Averages

The exponential moving average (EMA) improves on the simple moving average. It requires only two pieces of data: the previous average and the current datum. The classic calculation is A * (* = times) the previous MA + B * the new datum, where A + B = 1.0. Usually a small part of the new datum is added to a large piece of the old average. For instance, in an 18% exponential, A = 0.82 and B = 0.18. To relate that to the "real" world – the normal moving average – one uses the equation $B = 2 / (x + 1)$. In other words, a 18% exponential ($x = 10$) hugs the data about as closely as does a 10 day MA (2/ [10 + 1] = .18). The shape of the exponential is different because of the calculation; note in chart B the sharp angles as opposed to the more smooth normal moving average in chart A. Also, and importantly, it is much quicker to adjust to changing data. The length of the double-headed arrow is shorter because the exponential catches up to the data more quickly. Note, too, how it also gets detrimentally involved in the consolidation at the right.



An exponential, unlike the normal MA, cannot rise in the face of falling data, and vice versa. The exponential goes up and down in concert with the index it smooths. In some applications this is good. How fast it reacts to changes in the index it smooths is dependent upon the size of B. Too large and it moves too quickly; too small and it moves not swiftly enough. Again, some fitting is required to make it reflect the current situation. Certainly, it is much easier to adjust B mathematically than it is to adjust x in the simple moving average.

But note: if you "adjust" it well, it may fit today's data; but it most likely will not fit next year's, etc. Because it is fixed, it cannot adjust itself to the changing market, to the changing circumstance. This not withstanding, most people still fix x in stone. But the lengths of stock market cycles are not fixed in stone. What

Criteria for an Improved Smoothing Technique

In the ideal world, I submit the best smoothing technique would touch most of the following bases:

1. It would get whipsawed infrequently. It would stay on the "right" side of all moves of any real meaning. This certainly leaves much open to interpretation, but intentionally so. The user should have the ability to create his own definition, about which more is discussed below. Adjustment to circumstances is a minimum requirement.
2. It would "hug" the index as closely as desired, a corollary to the above. This presumes the calculation would be adjustable to your taste, i.e. if you like a 10-day MA, you could emulate its "closeness."
3. Most importantly, when the index slows, the average should also slow, and vice versa. When the index enters a trading range, ideally the average would stay out of that range as long as possible.
4. I believe a certain amount of being able to rise in the face of falling data and vice versa, similar to the moving average, is also desirable. Some might dispute that, but I believe this is in the nature of smoothing. My good friend Abe Savitsky (Savitsky-Golay, op. cit.) agrees because you need a certain degree of persistence!
5. Finally, it should be relatively easy to calculate. K.I.S.S. (Keep It Simple, Stupid). People will not adopt something that has too many Greek symbols, is too complicated, or that can be calculated only by a Cray computer, i.e. no boolian logic (ands, ors, ifs, if onlys, go froms, etc.).

The Solution: *The McGinley Dynamic*

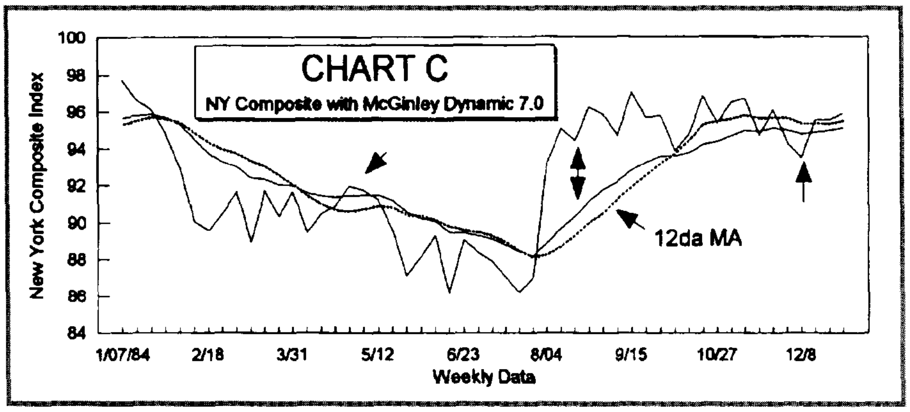
The calculation I propose meets all of the above criteria. It uses the rough format of Lloyd's Modified Moving Average[4] in that we modify the previous Dynamic (the first term) to come up with the current one; i.e. the second term of the equation is added to the first. The equation:

$$\text{New Dynamic} = \text{Dynamic}_{-1} + (\text{Index} - \text{Dynamic}_{-1}) / (N * (\text{Index}/\text{Dynamic}_{-1})^{4})$$

Here the Index might be the DOW, the S&P or a stock. By way of explanation, we're dividing the difference between the Dynamic and the index by N times the ratio of the two. The numerator difference gives us a sign, up or down, and the denominator keeps us percentage-wise within bounds defined by N. The 4th power gives the calculation an adjustment factor which increases more sharply the greater the difference between the Dynamic and the current datum. This makes the size of the adjustment – the second term – change not linearly, but logarithmically, a desirable feature, required in criteria 2.

N should be 60% of the normal moving average you are trying to emulate; e.g. to imitate a 20-day MA, use an N of 12. Refer to it as a **Dynamic 12.0**. From then on the Dynamic will adjust itself, speeding up or slowing down as the situation may dictate. The second term only comes into play in any meaningful way when the difference between the index and the Dynamic is relatively large. In effect this is like manually changing the length of a moving average as you go along, or changing B in the normal exponential; but here it happens automatically, dynamically.

Chart C shows how the Dynamic is an improvement over the normal moving average. You can see how in its crossing and recrossing the normal moving average it is slowing down and speeding up. Notice too how it almost avoids the whipsaw in the spring of 1984 (left arrow), but nevertheless comes out of it higher than it went in. In August it sharply moved upward (short double-headed arrow) in response to the breakout of prices. Finally, it stays out of the consolidation on the right hand third of the chart until the last moment, unlike the other methods (right arrow). Chart D illustrates the effect of changing N from 7.0 to 12.0; it does not respond as quickly to changes in prices similar to a longer moving average, nor does it hug the data as closely; that however, might be desirable to some in certain circumstances. The Dynamic avoids whipsaws caught by the normal moving average by speeding up and slowing down appropriately, just as desired. In short, it outdoes a moving average by adapting quickly and automatically to the changing market, which is just what we're looking for.



Benefits of *The McGinley Dynamic*

The benefits are legion: the Dynamic can rise in the face of falling data, similar to the normal moving average, but unlike the exponential. Additionally, as it only uses today's datum and yesterday's Dynamic, it avoids the "large dropoff" problem discussed above. Finally, of course, it uses only one piece of back data, unlike the normal moving average. In trending markets and in trading markets, it needs no adjusting, backtesting or optimizing because it is dynamic; it adjusts itself.

As you can see from the charts, the Dynamic avoids of most whipsaws the normal moving average gets involved in, and it rapidly moves up or down in concert with a swiftly changing market. Even in those whipsaws where it does get caught, it sells high and buys low. (It shouldn't be used as a trading vehicle, but some inevitably will try, so we must comment.)

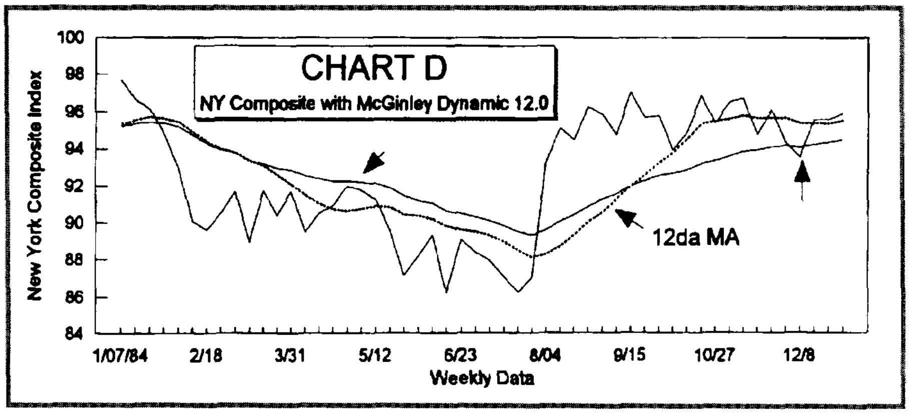
It must be noted the complete second term (after the plus sign) acts differently in up markets than in down markets. Fast up markets dampen (slow down) the Dynamic much less than down markets do. In down markets, the effect of the 4th power speeds up the Dynamic, making it catch up to the data faster than it does on the upside. To see this effect, use 10 for the old Dynamic, 6 for the close and use N = 7; you get –6.66. Alternatively, make the close = 14 and you get 0.15, quite a difference in as much as 14 is as far above the old Dynamic (10) as 6 is below it.

At first glance, this might be seen as a detriment. However, the rule is to let your profits run, yet be quick to jump when the market drops. This is exactly what the *McGinley Dynamic* does: it "babys" the market on the upside, staying far enough away to let profits run and not get whipsawed. Yet on the downside, it adjusts more quickly to any drop in order to cut losses.

Future Challenges

Down the line, we want to add the ability to include some measurement of volatility in order to crank the Dynamic up/down more effectively. A calculation less complicated than the usual standard deviation is being sought for simplicity's sake. When the market loses volatility and enters a trading range, we want the *McGinley Dynamic* to stay out of the trading range as long as possible.

There are number of alternate techniques other authors have put forth to accomplish the task we have set out here. A summary is in the Appendix.



Addendum

Unfortunately it is not possible to program The *McGinley Dynamics* into most of the popular charting programs at present. This is because the Dynamic calculation requires "recursive" programming, i.e. the ability to utilize a calculation from yesterday in today's calculation. Any spreadsheet can do this, but not many charting programs for reasons which I've had explained to me, but which, given how valuable a recursive ability could be, I find hard to understand. Most charting programs can do this only with their hard-wired functions. In other words, if an exponential MA had not been hard-wired into some of these programs, you wouldn't be able to program one in because an exponential requires recursive programming. *Window on Wall Street* will be able to do it when an upgrade to the next version arrives, probably in the winter of 1997-8. *TechniFilter* includes recursive ability in its testing module, *Supercharts* can do it with difficulty and *TradeStation* can do it easily. The current Windows 95 version of *Metastock* finally can now do it as well.

Footnotes

1 *See detailed chapter on various moving averages in Kaufman.*

2 *A paper applying this calculation to the stock market by Abraham Savitsky and John McGinley is in the works. One of its most important contributions to technical analysis is the ability to calculate the first derivative of the data at a given point, something not otherwise possible at present.*

3 *A detailed discussion of applying a single moving average to the market may be found in Colby and Meyers. Even the "best" moving average lengths, 54 weeks and 11-12 months, were only marginally profitable after taxes and commissions.*

4 *An idea of Humphrey Lloyd, the "modified moving average" is a simplified version of the EMA. It does away with A and uses only B. If B is calculated properly, it will almost exactly reproduce the Exponential but with a little less math. The calculation is old average + B * new datum.*

5 *See Dobson for details and construction and use of Bollinger Bands.*

Bibliography

Colby and Meyers, Encyclopedia of Technical Market Indicators, Dow Jones, Irwin, 1988

Dobson, Edward D., Understanding Bollinger Bands, Traders Press, 1994

Kaufman, Perry J., New Commodity Trading Systems and Methods, John Wiley & Sons, 1987

Lloyd, Humphrey, The Moving Balance System, Windsor, 1976

Savitzky & Golay, *Smoothing and Differentiation of Data by Simplified Least Squares Procedures,* Analytical Chemistry, Vol. 36, July 1964

Appendix

New Directions In Smoothing Techniques

1. **McGinley Dynamics** ©1990

   $MD = MD_{-1} + (DJIA - MD_{-1}) / (N * (DJIA / MD_{-1}))$

   where: MD_{-1} = McGinley Dynamic yesterday

   N = 60% of equivalent MA (e.g. for 10da, use 6)

   * = multiplication

2. **New McGinley Dynamics** ©1994

   Same as above only final term is raised to 4th power:

   $(N * (DJIA / MD_{-1})^4)$

3. **Adaptive MA**

   (Perry Kaufman, Smarter Trading, p.140)

   Adaptive MA (AMA) = $AMA_{-1} + ((0.6022 * ER) + 0.0645)^2 * (DJIA - AMA_{-1})$

   where: ER (Efficiency Ratio) = Directionality / Volatility (ie., noise or choppiness)

   Directionality = gross change over period (n days)

   Volatility = sum of absolute individual changes over period (n days)

4. **Metastock Variable MA**

   (Equis International, T. Chande, Stocks & Commodities, 3/92)

   $VMA = (T * VR * DJIA) + ((1 - T) * VR * VMA_{-1})$

   where: VR (Volatility Ratio) = VHF / VHF_{-n}

   VHF (Vertical Horizontal Filter) = (Highest close – Lowest close over (n) periods), divided by sum of the absolute changes in the (n) periods. (Adam White, Futures, August 1991)

   T = 2 / (N + 1) where: N = equivalent length MA

5. **Variable Length MA**

   (An experimental idea in Stocks & Commodities, June 1991)

   If DJIA outside 1 standard deviation, decrease n by one day.

   If DJIA outside 2 standard deviations, decrease n by 2 days.

   ..... and vice versa. But how often?

6. **Choppiness Index**

   (E.W. Dreiss, Futures, 10/93) Use in place of ER, VHF above?

   CI = 100 * Log (sum of n days' True Ranges / (highest true high - lowest true low)) / log (n)

   where: True Range = highest of previous close or today's high minus lowest of previous close or today's low.

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Legendary technician Arthur Merrill began Technical Trends in 1960. John began assisting him in 1982, ultimately taking over as editor when Mr. Merrill retired in 1987, and has been keeping the flame alive ever since.

Previously, John had worked on both sides of the street, but was unable to get them together. On graduation from Harvard, he began financial training at Citibank prior to discovering the alluring charms of the stock market.

He appears periodically on CNBC and has published numerous articles on technical indicators in various media. He is the inventor of the **Double Power Scale** method of constructing charts and is creator of the **McGinley Dynamics**, a superior calculation to the moving average. Technical Trends is the unique source of several indicators; many original and some created by others, such as the **Wysong Value-Weighted Put/Call Indicator**, invented by Perry Wysong and their version of Richard Russell's **Primary Trend Index**. (www.capecod.net/techtrends)